Partial Translation of JP 10(1998)-332933 A

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Title of the Invention :

OPTICAL ANISOTROPY ELEMENT

Translation of paragraphs [0144] to [0154]

[0144]

Next, a layer (B) that exhibits a negative anisotropy (hereinafter, referred to as a "negative anisotropy exhibiting layer (B)") will be described. The negative anisotropy exhibiting layer (B) according to the present invention satisfies $nz < ny \leq nx$ and $(1/nz^2 - 1/ny^2) > (1/ny^2 - 1/nx^2)$, where nx and ny represent in-plane principal refraction indices and nz represents a principal refraction index in the thickness direction.

[0145]

The negative anisotropy exhibiting layer (B) has a thickness d ranging preferably from 10 μm to 500 μm, more preferably from 40 μm to 200 μm. When the layer (B) is thinner than 10 μm, an effect of improving a viewing angle achieved by the optical anisotropy element may not differ from the case where the optical anisotropy film (A) alone is used in the optical anisotropy element. On the other hand, when the negative anisotropy exhibiting layer (B) is thicker than 500 μm, the resultant optical anisotropy element may have a problem with regard to its reliability and operability when installing it in a device.

[0146]

A retardation value Δndz of the negative anisotropy exhibiting layer (B) in its thickness direction represented by $\{(nx + ny)/2 - nz\} \cdot d$ preferably is 20 to 500 nm. When Δndz is smaller than 20 nm, a sufficient effect of improving a viewing angle may not be obtained. On the other hand, when

Δndz is greater than 500 nm, the negative anisotropy exhibiting layer (B) is too thick, which may cause undesired coloring of a liquid crystal display.

[0147]

Furthermore, a retardation value Δnd of the negative anisotropy exhibiting layer (B) in its front direction represented by $(nx - ny) \cdot d$ preferably is 0 to 40 nm.

[0148]

It is to be noted that a plurality of negative anisotropy exhibiting layers (B) may be arranged on one or both surfaces of the optical anisotropy film (A). In the case where a plurality of negative anisotropy exhibiting layers are arranged, Δnd preferably is in the range from 0 to 40 nm and Δndz preferably is in the range from 20 to 500 nm, where Δndz and Δnd represent in this case total values with regard to all the negative anisotropy exhibiting layers present between the optical anisotropy film (A) and either one of a liquid crystal layer, an upper polarizing plate, and a lower polarizing plate of the liquid crystal cell for driving the optical anisotropy element.

[0149]

The negative anisotropy exhibiting layer (B) can exhibit an effect of improving a viewing angle to some extent, regardless of its arrangement relative to the optical anisotropy film (A) or its configuration. The reason for this is as follows. The negative anisotropy exhibiting layer (B) satisfies $nz < ny \leq nx$ and $(1/nz^2 - 1/ny^2) > (1/ny^2 - 1/nx^2)$, where nx and ny represent in-plane principal refraction indices and nz represents a principal refraction index in the thickness direction and the retardation value Δnd in its front direction represented by $(nx - ny) \cdot d$ is as small as 0 to 40 nm, as described above. Thus, an anisotropy is generated within the plane of the negative anisotropy exhibiting layer (B) when $ny \neq nx$ is satisfied in the above formulae, which causes a directivity to be generated when the layer (B) is arranged on the optical anisotropy film (A). However, such directivity gives only a negligible effect on the function of the optical anisotropy element.

[0150]

However, in order to achieve a more suitable effect of improving a viewing angle using the optical anisotropy element of the present invention, an angle that the tilt direction of the optical anisotropy film (A) forms with either of the in-plane principal refraction index directions (two directions

that cross at right angle within the plane) is generally set to −15° to 15°, preferably −10° to 10°, and more preferably −5° to 5°. The optical anisotropy element satisfying the above arrangement condition can achieve the most suitable display characteristics such as a contrast, in particular, when it is seen from the front side.

[0151]

When the layer (B) is disposed between polarizing plates that are in crossed-Nicols arrangement and then the layer (B) is rotated, the minimum Y value (the spectral transmittance or reflectance reflecting the luminous factor correction (JIS-Z8701)) of light transmitted therethrough, which is 0 or a value other than 0, appears every time the layer (B) is rotated about 90°. The in-plane principal refraction index directions of the negative anisotropy exhibiting layer (B) are directions in which the minimum Y value, which is 0 or a value other than 0, matches the transmission axis or the absorption axis of the upper/lower polarizing plate. In the case where the negative anisotropy exhibiting layer (B) is a film obtained by a certain stretching process, the in-plane principal refraction index directions generally are present in the MD direction and the TD direction of the film.

[0152]

The negative anisotropy exhibiting layer (B) is not particularly limited as long as it has the above-descried optical parameters. Examples of the material used for forming the layer include a plastic sheet, a plastic film, a plastic substrate, and a substrate formed of a material other than plastics, exhibiting a negative anisotropy. The sheet, film, substrate, etc. may have a self-supporting property or may be free from a self-supporting property. When a material that does not have a self-supporting property is used for forming the negative anisotropy exhibiting layer (B), the material may be held on a self-supporting film or substrate by some means so that the thus-obtained laminate as a whole exhibits the negative anisotropy with the above-described optical parameters. Alternatively, it is possible to form the negative anisotropy exhibiting layer (B) by applying a melt or a solution of a compound or composition that can form a layer exhibiting an optically negative anisotropy onto the optical anisotropy film (A) and then performing alignment control by means of electric field, magnetic field, polarized radiation, or the like. However, when applying the melt or solution, care should be taken not to cause irregularities of the nematic hybrid alignment

of the optical anisotropy film (A), decrease in the film strength, etc. In general, a plastic sheet, a film, a substrate, or the like is used as the optically negative anisotropy exhibiting layer (B).

[0153]

Specific examples of the above-described negative anisotropy exhibiting layer (B) include:

(1) optical films that are commercially available under the trade names of FUJITAC (Fuji Photo Film Co., Ltd.), ZEONEX (ZEON Corporation), and ARTON (Japan Synthetic Rubber);

(2) films formed of polystyrene, polyimide, or polyester, exhibiting a negative anisotropy;

(3) cholesteric alignment films formed of liquid crystal polymers exhibiting an optically positive uniaxiality, disclosed in JP 6(1994)-186534 A, for example; and

(4) films in which discotic liquid crystal is immobilized in the state where it is in homeotropic alignment. An optical anisotropy element according to the present invention can be obtained by arranging/forming at least one negative anisotropy exhibiting layer (B) on one or both surfaces of the above-described optical anisotropy film (A).

[0154]

In the following, the method for arranging/forming the negative anisotropy exhibiting layer (B) will be described specifically. The optical anisotropy film (A) generally is formed on an alignment substrate, when it is obtained by the process described in the above. Therefore, when a substrate that exhibits a negative anisotropy is used as this alignment substrate, an optical anisotropy element according to the present invention can be obtained by forming an optical anisotropy film (A). The optical anisotropy element obtained in this manner may further include another negative anisotropy exhibiting layer(s) (B) laminated on the optical anisotropy film (A) side and/or the negative anisotropy exhibiting layer layer (B) (as the alignment substrate) side.

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